(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 September 2001 (13.09.2001)

PCT

(10) International Publication Number
WO 01/66345 A1

(51) International Patent Classification[7]: B32B 5/08, D04H 13/00

(21) International Application Number: PCT/US01/06909

(22) International Filing Date: 2 March 2001 (02.03.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/186,590 3 March 2000 (03.03.2000) US

(71) Applicant *(for all designated States except US)*: **THE PROCTER & GAMBLE COMPANY** [US/US]; One Procter & Gamble Plaza, Cincinnati, OH 45202 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BRENNAN, Jonathan, Paul** [US/US]; 4459 Hickory Nut Court, Cincinnati, OH 45241 (US). **GORLEY, Ronald, Thomas** [US/US]; 7835 New Brunswick Drive, Cincinnati, OH 45241 (US).

(74) Common Representative: **THE PROCTER & GAMBLE COMPANY**; c/o Mr. Reed, David, T., 5299 Spring Grove Avenue, Cincinnati, OH 45217 (US).

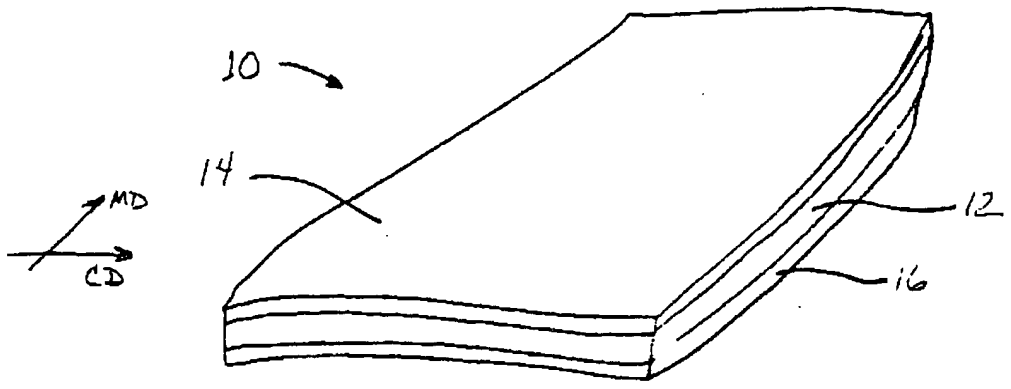
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ABSORBENT, NON-LINTING NONWOVEN WEB



(57) Abstract: The nonwoven web of the present invention is a layered structure that takes advantage of the beneficial properties of different types of fibers advantageously distributed in each layer. In particular, the present invention is a multi-layer airlaid nonwoven web suitable for use as a wet wipe, the web having a first fibrous outer layer comprising from about 50 % to about 100 % conjugate fiber, and from about 0 % to about 60 % cellulosic fibers, and a fibrous inner layer bonded at discrete bond sites to the first outer layer in a face to face relationship comprising from about 15 % to about 40 % conjugate fiber, and from about 50 % to about 90 % pulp fibers. A second fibrous outer layer, which can be the same composition as the first outer layer, is bonded at discrete bond sites to the inner layer in a face to face relationship. A method for forming the web of the present invention is also disclosed.

WO 01/66345 A1

ABSORBENT, NON-LINTING NONWOVEN WEB

CROSS REFERENCE

This application claims the benefit of US Provisional Application No. 60/186,590, filed on March 3, 2000.

FIELD OF THE INVENTION

The present invention is related to nonwoven materials. In particular, the present invention is related to absorbent, non-linting nonwoven materials suitable for use as a substrate for pre-moistened wipes.

BACKGROUND OF THE INVENTION

Nonwoven fabrics are desirable for use in a variety of products such as bandaging materials, garments, disposable diapers, and other personal hygiene products, including pre-moistened wipes. Pre-moistened wipes are often packaged as discrete wipes in a stack in a moisture proof container, and are often referred to as wet wipes. Wet wipes are commonly used as baby wipes for the cleaning of a baby's skin during a diaper change.

Nonwoven webs having high levels of strength, thickness, drape, and softness are desirable for body-contacting articles, such as linings for disposable diapers and wet wipes. However, optimizing all the desirable properties is often not commercially feasible. For example, often a balance of properties results in less than desirable softness or strength levels. Wet wipes used as baby wipes, for example, should be strong enough when wet to maintain integrity in use, but absorbent enough to retain aqueous fluids, oil/water emulsions, and the like. The fluid retention properties should be such that the wipes remain wet during storage, and remain wet enough to be effective in cleaning the soiled skin of a user.

Strength in a nonwoven fabric can be generated by a variety of known methods. If thermoplastic fibers are used, strength can be imparted by melting, either by through-air

bonding or by hot roll calendaring. Hydroentangling fibers in a spunlace operation and adhesive bonding are also commonly used to bind fibers to increase the strength of the nonwoven. However, these processes, while increasing the strength of the nonwoven, generally detract from other desirable properties. For example, thermal bonding is effective at maintaining the thickness (bulk) of the nonwoven, but maintaining a relatively soft product suitable for wet wipes requires the use of relatively expensive conjugate (e.g., bicomponent) fibers throughout the nonwoven web. The use of large amounts of conjugate fibers throughout the nonwoven can also negatively affect the drape of the resulting material.

Hydroentangling a fibrous structure generates strength, but typically reduces the thickness of the material. Such a reduction in thickness is undesirable in a wet wipe application. Due to the nature of cleaning tasks for which wet wipes are used, consumers prefer a wipe that has a minimum amount of apparent bulk, or thickness associated with it. To increase the basis weight of the starting material such that after hydroentangling the material retains sufficient thickness to be used as a baby wipe would be prohibitively expensive.

Adhesive bonding can be used to generate sufficient strength, especially in a carded web. However, adhesive adds to the expense of the resulting web, often costing more than the fibers of the base web to which it is applied. Additionally, the presence of adhesive can negatively impact the fragrance and preservative ingredients in a wet wipe. Adhesive application systems also add cost and complexity to a nonwoven manufacturing process, as well as creating hygiene problems in the application equipment and other equipment in the vicinity. Finally, adhesive can contribute to the stiffness of the final nonwoven, which lowers the drape and perceived softness of the material.

Absorbency in a nonwoven web is typically achieved by the use of high levels of pulp fibers throughout the web. However, one drawback to the use of pulp fibers is "linting". Linting, or pilling, occurs as fibers, or small bundles of fibers, are pulled off, or otherwise released from, the surface of the nonwoven substrate of the wet wipe. Linting can result in fibers remaining on the skin of the user, a highly undesirable condition for wet wipe users.

Linting can be controlled in much the same way that strength is imparted. That is, to the extent that fibers of the nonwoven are bonded to, or entangled with, one another, linting levels can be controlled. Therefore, by increasing the level of adhesive in a carded web, for example, linting can be decreased. However, as mentioned above, the increased level of adhesive contributes to greater stiffness and decreased levels of softness.

Accordingly, it would be desirable to have an absorbent, nonwoven web suitable for use as a wet wipe, and having suitable strength to maintain structural integrity during use and not lint.

Additionally, it would be desirable to have an absorbent, nonwoven web suitable for use as a wet wipe exhibiting relatively low levels of linting without the use of stiffness-increasing additives, such as the addition of adhesive.

Additionally, it would be desirable to have an absorbent, nonwoven web suitable for a wet wipe that exhibits relatively high retention of fluids such as aqueous fluids, and relatively high strength, but remains soft to the skin, with sufficient absorbency for effective skin soil cleaning.

Finally, it would be desirable to have an absorbent, nonwoven web, suitable for a wet wipe that can be made with a relatively high strength and softness, without linting, and can be made economically.

SUMMARY OF THE INVENTION

The nonwoven web of the present invention is a layered structure that takes advantage of the beneficial properties of different types of fibers advantageously distributed in each layer. In particular, the present invention is a multi-layer airlaid nonwoven web suitable for use as a wet wipe, the web having a first fibrous outer layer comprising from about 50% to about 100% conjugate fiber, and from about 0% to about 60% cellulosic fibers, and a fibrous inner layer bonded at discrete bond sites to the first outer layer in a face to face relationship comprising from about 15% to about 40% conjugate fiber, and from about 50% to about 90% pulp fibers. A second fibrous outer

layer, which can be the same composition as the first outer layer, is bonded at discrete bond sites to the inner layer in a face to face relationship.

A method for forming the web of the present invention is also disclosed.

BRIEF DESCRIPTION OF THE INVENTION

FIG. 1 is a simplified perspective view of one embodiment of a nonwoven web of the present invention utilized as a wet wipe.

FIG. 2 is a schematic representation of an apparatus for producing a nonwoven web of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The nonwoven web **10** of the present invention is a layered structure that takes advantage of the beneficial properties of different types of fibers advantageously distributed in each layer. In particular, in a preferred embodiment, as shown in FIG. 1, the nonwoven web of the present invention is at least a three-layer structure having at least one relatively high basis weight central layer **12** disposed between two relatively low basis weight outer layers, **14** and **16**. By "layer" as used herein is meant a portion of a web that is formed apart from other layers, for example by its own card in a carding operation, prior to being joined to adjacent layers to form a unitary web. A layer is made as a relatively homogeneous web, that is, the constituent fibers are relatively evenly distributed within the layer.

When formed by the method of the present invention, the nonwoven web **10** exhibits a good balance of strength, extensibility, thickness, absorbency, and softness which properties are desirable for body-contacting articles, such as linings for disposable diapers and wet wipes. The web **10** also exhibits very low levels of linting, which makes the it particularly useful as a substrate for pre-moistened wipes, otherwise known as wet wipes. However, it is recognized that the nonwoven web **10** can have other beneficial uses as

well. Therefore, a wet wipe is taught herein as a preferred, but non-limiting use for the nonwoven web **10**.

In a preferred embodiment, the constituent layers of the nonwoven web **10** are formed by an air laying process. Air laying is a process whereby air is used to separate, move, and randomly deposit fibers from a forming head to form a coherent, and largely isotropic web. Air laying equipment and processes are known in the art, and include Kroyer or Dan Web devices (suitable for wood pulp air laying, for example) and Rando webber devices (suitable for staple fiber air laying, for example).

The nonwoven web **10** of the present invention and a method of making are now described below with reference to FIGs. 1 and 2, respectively.

THE NONWOVEN WEB

In a preferred embodiment, the two outer layers **14** and **16** of nonwoven web **10** are identical, and each will be so described in detail herein with reference to outer layer **14**. However, it is recognized that the two outer layers need not have identical compositions to obtain the benefits of the absorbent, low-linting nonwoven web of the present invention.

The invention is described below as a three-layer web having a single inner layer with two outer layer. However, it is recognized that there can be more than one inner layer. For example, instead of one forming head making the inner layer, two or more forming heads can make up two or more inner layers. However, the percentages for the various properties of the inner layer below can apply to the inner layers as a whole, if more than one inner layer is used between the outer layers.

In the preferred embodiment described herein, the nonwoven web **10** is formed without the use of adhesive. That is, the web is formed by a method that does not involve the application of adhesive, and therefore the finished layered unitary web is characterized by the absence of adhesive or an adhesive component. Although in less preferred embodiments an adhesive can be used, in a preferred embodiment the layers are held together to form a unitary web only by fiber to fiber thermal bonds.

In each layer of the nonwoven web **10** of the present invention a combination of fiber types is utilized to optimize the beneficial properties of each. For example, the outer layers can have a certain percentage of cellulosic fibers to give the web a soft, cloth-like feel; while the inner layer may have a certain percentage of the same or similar cellulosic fibers, but preferably has a relatively high percentage of pulp fibers to provide for improved absorbency. Each layer also has a certain percentage of multi-component, or conjugate fiber, such as bicomponent fiber, to provide for thermal bonding and softness. In all the embodiments and examples described herein, the conjugate fiber is bicomponent fiber. However, one skilled in the art will recognize that other conjugate fibers can be used with equivalent benefits and results. Other fibers may be added as necessary for additional properties, but in a preferred embodiment, the nonwoven web **10** of the present invention comprises the above-mentioned pulp, cellulosic, and bicomponent fibers in pre-determined proportions, as described more fully below.

The outer layers **14** and **16** can each make up from about 10% to about 25% of the total basis weight of nonwoven web **10**. In a preferred embodiment, each outer layer is about 12% to about 22% of the total basis weight of nonwoven web **10**, and in one embodiment the two outer layers **14** and **16** are identical and each comprised about 16% of the total basis weight of the nonwoven web **10**.

The inner layer **12** can make up from about 50% to about 80% of the total basis weight of nonwoven web **10**. In a preferred embodiment, the inner layer is about 56% to about 72% of the total basis weight of nonwoven web **10**, and in one embodiment the inner layer **12** comprised about 68% of the total basis weight of the nonwoven web **10**.

The outer layers **14** and **16** should have sufficient quantity of conjugate fibers to permit adequate fiber-to-fiber bonding within the layers, and fiber-to-fiber bonding with fibers in the central layer **12**. Adequate fiber-to-fiber bonding is achieved when loose surface fibers are "tied down" such that they are not easily dislodged from the nonwoven web in the form of lint. Therefore, each outer layer can have from about 50% to 100% bicomponent fibers. Each outer layer can have about 55% to about 75% bicomponent fibers, and in one embodiment the two outer layers **14** and **16** each comprised about 60%

bicomponent fibers. Without being bound by theory, it is believed that 50% is the minimum amount of bicomponent fibers necessary to adequately tie down loose surface fibers for consumer-acceptable low-linting wet wipe applications.

The inner layer **12** should also have sufficient quantity of conjugate fibers to permit adequate fiber-to-fiber bonding, particularly bonding with the fibers of the outer layers. Although a structure of separate layers permits preferential distribution of fiber types, it remains important that the constituent layers perform as a unitary web when utilized as a wet wipe, particularly in a baby wipe application. Delamination of the layers during use detracts from the consumer benefits delivered from such a wet wipe. Therefore, to avoid delamination of the layers, the inner layer can have from about 15% to about 40% conjugate fibers. The inner layer can have about 18% to about 35% conjugate fibers, and in one embodiment the inner layer **12** comprised about 20% bicomponent fibers which, without being bound by theory, is believed to be the minimum amount necessary to maintain structural integrity and to prevent delamination in consumer-acceptable wet wipe applications.

The outer layers **14** and **16** can have sufficient quantity of cellulosic fibers to give the nonwoven web **10** a soft, clothlike feel. Each outer layer can have from about 0% to about 60% cellulosic fibers. Each outer layer can have about 25% to about 60% cellulosic fibers, and in one embodiment the two outer layers **14** and **16** each comprised about 40% cellulosic fibers.

The inner layer **12** can have a quantity of cellulosic fibers sufficient to give the nonwoven web **10** adequate absorbency. Especially when used as a wet wipe, each wipe should exhibit sufficient absorbency to absorb and hold aqueous fluids or lotions prior to use. Additionally, fluid, such as urine, should be sufficiently absorbed so as to make the wipe is effective in cleaning tasks associated with baby wipes. The inner layer can have from about 50% to about 90% cellulosic fibers. The inner layer can have about 65% to about 85% cellulosic fibers, and in one embodiment the inner layer **12** comprises about 80% cellulosic fibers, specifically fluff pulp fibers which provides adequate absorbency in

consumer-acceptable wet wipe applications. A preferred pulp fiber is Foley Fluff available from Buckeye Technologies, Memphis, TN.

For each of the layers the conjugate fibers can be of a core/sheath design, and are preferably comprised of polypropylene (as the core) and polyethylene (as the sheath). In a preferred embodiment the conjugate fibers can be about 6 mm in length and about 1.5 denier. A preferred bicomponent fiber is a available as Al-Adhesion-C from FiberVisions, Covington, GA.

For the outer layers the cellulosic fibers, if used, can be rayon or lyocell, and in a preferred embodiment are fibers low denier rayon or lyocell fibers having a length of about 6 mm. In a preferred embodiment, the rayon is 1.5 denier. A preferred fiber is a solvent spun cellulose available as TENCEL® lyocell, from Acordis Cellulosic Fibers, Axis, AL.

Further examples of webs of the present invention found beneficial as wet wipes are shown in the Examples below. The examples shown are meant to be exemplary and not limiting. Each of the example webs has a basis weight of 65 grams per square meter (gsm), but varying levels of the constituent fibers in each layer.

Example 1:

	Basis Weight (gsm)	Pulp %	BiCo %	Rayon (Lyocell) %	Pulp (gsm)	BiCo (gsm)	Rayon (Lyocell) (gsm)
Outer Layer	11.6	0	50	50	0.0	5.8	5.8
Inner Layer	41.8	65	35	0	27.2	14.6	0.0
Outer Layer	11.6	0	50	50	0.0	5.8	5.8
Total	65	41.8%	40.4%	17.9%	27.2	26.2	11.6

Example 2

	Basis Weight (gsm)	Pulp %	BiCo %	Rayon (Lyocell) %	Pulp (gsm)	BiCo (gsm)	Rayon (Lyocell) (gsm)
Outer Layer	9.0	0	60	40	0.0	5.4	3.6
Inner Layer	47.0	80	20	0	37.6	9.4	0.0
Outer Layer	9.0	0	60	40	0.0	5.4	3.6
Total	65	57.8%	31.1%	11.1%	37.6	20.2	7.2

Example 3

	Basis Weight (gsm)	Pulp %	BiCo %	Rayon (Lyocell) %	Pulp (gsm)	BiCo (gsm)	Rayon (Lyocell) (gsm)
Outer Layer	8.13	0	100	0	0.0	8.1	0.0
Inner Layer	48.75	80	20	0	39.0	9.8	0.0
Outer Layer	8.13	0	100	0	0.0	8.1	0.0
Total	65	60%	40%	0%	39.0	26.0	0.0

For a web of the present invention, the wipes have a very pleasing surface feel due to the 100% synthetic nature of the outer, body contacting surfaces. Additionally, the structural integrity of the surface layers provides for sufficient structural integrity to

prevent significant amounts of linting. Because no adhesive components are utilized, the wipe exhibits superior drape properties compared to adhesive-bonded airlaid webs. The synthetic fiber content of the outer layers, together with the cellulosic pulp content of the inner layer provides for a wipe that is soft to the skin, but has sufficient abosrbency for effective skin soil cleaning. In part because the wipe is produced on conventional air laid processes without the addition of adhesive, the wipe can be made economically.

METHOD FOR MAKING

FIG. 2 shows a schematic representation of an apparatus for use in a preferred method of making the nonwoven web **10** of the present invention. As shown in FIG. 2, the method is an airlaying process, with subsequent through-air bonding and calendaring of the multi-layer substrate. Without being bound by theory, it is believed that the sequence of steps in the method described herein with reference to FIG. 2 is important to achieving the beneficial web properties, as described below.

An apparatus, generally designated at **20**, comprises an airlaying apparatus having at least three forming heads designated at **22**, **24**, and **26**. Each forming head can form a discrete nonwoven web. The first forming head **22** forms a web corresponding to layer **16** as depicted in FIG. 1. Likewise, forming heads **24** and **26** form webs corresponding to layers **12** and **14**, respectively.

Each airlaid web can be formed by airlaying methods known in the art, and deposited by known methods onto a forming belt or screen **28**. As all three layers are formed on forming screen **28**, forming screen **28** is moved in the machine direction **MD** by rolls **29**. In this way, nonwoven web **10** can be formed in a continuous process. The direction of forming is referred to as the machine direction **MD**, while the width of the web is measured in the cross direction **CD**.

The fiber composition of the fiber supply for each forming head can be predetermined, formulated and/or adjusted by methods known in the art for supplying airlaying processes.

After all three layers airlaid webs are deposited in a layered relationship, the deposited fibers are moved by forming screen **28** to a compacting treatment apparatus, such as embossing apparatus **30**. The compacting treatment compresses the airlaid fibers to a predetermined uniform thickness, and ensures adequate fiber to fiber contact between the conjugate fibers used for thermal bonding, as discussed below. The amount of compacting necessary depends upon the total basis weight of the web being processed, as well as the final thickness desired, and the amount of conjugate fiber in each layer.

The compacting can be generally uniform, such as by feeding the airlaid webs between two relatively smooth calendaring rollers, such as smooth steel rollers. The compacting can also include embossing, such as by feeding between two rollers, one or both of which have protuberances that emboss discrete regions of the web to a greater degree than the non-embossed regions.

After compacting, the web is transferred in the machine direction to a thermal treatment apparatus **40**. Thermal treatment apparatus **40** can incorporate any of known methods for subjecting the layered web to sufficiently elevated temperatures so as to effect thermoplastic melting of the polyethylene component (or other lower melting point component) of the constituent conjugate fibers. Upon cooling, portions of the conjugate fibers remain melt-bonded to portions of adjacent conjugate fibers, thereby forming the three layers into a unitary web having substantially uniform distribution of layer to layer bond sites.

Fiber to fiber thermal bonds can be made by methods known in the art. In preferred embodiments, thermal bonds are made via a flat bed heating oven **42** wherein heat is transferred by convection through the web to be heated. Another method that is commercially sufficient is through-air drying via a through-air drying drum which the web is transferred onto for a predetermined dwell time. The advantage of using either a flat bed heating oven or a through-air dryer is that the web is heated sufficiently with little or no compression. In this manner, the constituent layers of the web can be bonded together due to the conjugate fiber-to-conjugate fiber bonding, without unnecessary compression of calendaring rollers, for example. Without wishing to be bound by theory, it is believed that

the thermal bonding step tends to "set" the loft of the nonwoven by effecting bonding without additional unnecessary compression. This "loft setting" produces a bulkier sheet for better thickness in the end product. By using the composition percentages described above, the thickness of the finished product is believed preferred by consumers using the web as a wet wipe.

The through-air thermal bonding process can be carried out by methods known in the art for thermally drying webs, including paper webs. For any given method, the air temperature, air volume, and machine direction line speed of production can be adjusted to ensure sufficient dwell time for adequate fiber-to-fiber bonding. The actual time, temperature, and line speed can be varied as appropriate, and is not considered to be critical.

After being thermally bonded, the layered, bonded web is then continues for further processing to a calendaring apparatus 50. Calendaring apparatus 50 preferably comprises embossing or thermal embossing means to impart an embossed pattern of compressed regions onto the layered, bonded, carded web. The embossing means can include standard embossing patterns and equipment as are known in the art.

By embossing the layered, bonded nonwoven web, the nonwoven web can gain better aesthetics, particularly for use as a wet wipe. However, besides better aesthetics, other beneficial physical characteristics are imparted to the nonwoven web by calendaring. For example, by calendaring the web at sufficiently elevated temperatures additional thermal bonding is achieved in the compressed regions, thereby giving better surface fiber bonding. This surface fiber bonding "ties down" loose fiber, resulting in reduced linting of the finished web. Additionally the thermal bonding of the calendaring operation increases the strength of the nonwoven web 10, especially when used in a wet wipe application. The added embossing also produces a web having a topography that exhibits sufficient texture and porosity for effective skin soil cleaning Finally, the thermal emboss contributes to reducing the available cross-direction CD stretch of the finished web. Excessive CD stretch is often a characteristic of carded webs, and is generally undesirable in a wet wipe.

By reducing CD stretch, the stretch properties of the web are more uniform, and more suited for use as a wet wipe.

The layered, bonded, and calendared web can then be wound as roll stock on a parent roll 60 for storage or further processing.

While particular embodiments and/or individual features of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. Further, it should be apparent that all combinations of such embodiments and features are possible and can result in preferred executions of the invention. Therefore, the appended claims are intended to cover all such changes and modifications that are within the scope of this invention.

WHAT IS CLAIMED IS:

1. A multi-layer airlaid nonwoven web suitable for use as a wet wipe, the web comprising:
   (a) a first fibrous outer layer comprising from 50% to 100% conjugate fiber, and from 0% to 60% cellulosic fibers;
   (b) a fibrous inner layer comprising from 15% to 40% conjugate fiber, from 50% to 90% pulp fibers, said inner layer bonded at discrete bond sites to said first outer layer in a face to face relationship; and
   (c) A second fibrous outer layer comprising from 50% to 100% conjugate fiber, from 0% to 60% cellulosic fibers, said second fibrous outer layer bonded at discrete bond sites to said inner layer in a face to face relationship.

2. The nonwoven web of Claim 1, wherein said first and second outer layer comprise identical fiber compositions.

3. The nonwoven web of Claim 1, wherein said first and second outer layers together comprise from 28% to 44% of the total basis weight of the web.

4. The nonwoven web of Claim 1, wherein said first and second outer layers each comprise 14% to 22% of the total basis weight of the web.

5. The nonwoven web of Claim 1, wherein said inner layer comprises from 56% to 72% of the total basis weight of the web.

6. The nonwoven web of Claim 1, wherein said web is formed in the absence of adhesive.

7. A method for forming a multi-layer airlaid nonwoven web suitable for use as a wet wipe, the method comprising the steps of:

(a) providing first, second and third airlaid webs, each said web having a predetermined amount of conjugate fibers;

(b) providing a compacting apparatus;

(c) providing a thermal treatment apparatus;

(d) providing a calendar emboss apparatus;

(e) positioning the first, second, and third airlaid webs in a layered, face-to-face relationship;

(f) compacting said layered first, second and third airlaid webs;

(g) transferring said layered first, second and third airlaid webs to said thermal treatment apparatus;

(h) heating said layered first, second and third carded webs for sufficient dwell time to effect bonding between a plurality of said conjugate fibers to form a bonded unitary web;

(i) transferring said unitary web to said calendar emboss apparatus; and

(j) embossing said unitary web to said calendar emboss.

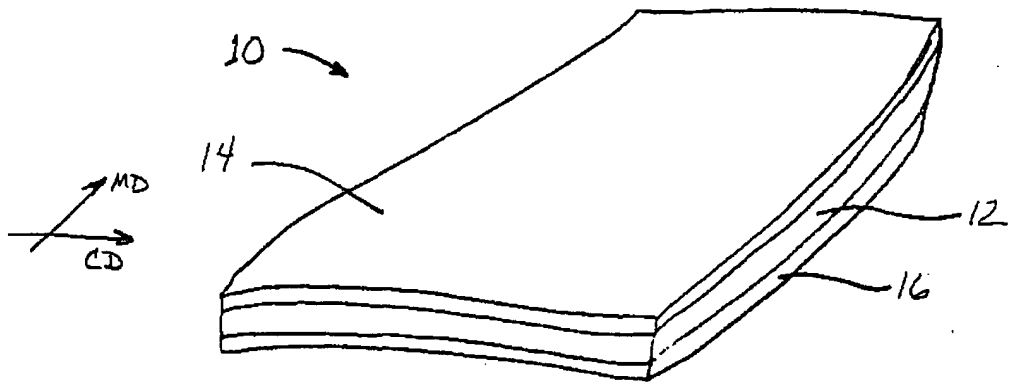


FIG 1

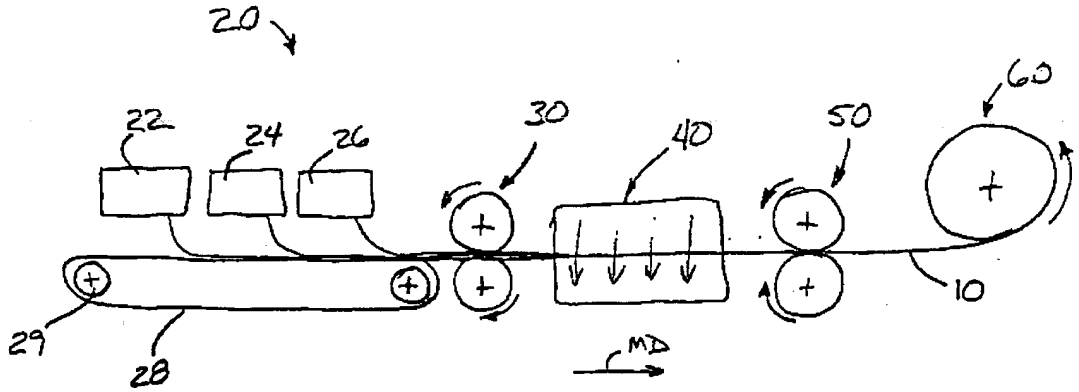


FIG 2

INTERNATIONAL SEARCH REPORT

	International Application No PCT/US 01/06909

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B5/08 D04H13/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B D04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 294 478 A (GEORGER WILLIAM A ET AL) 15 March 1994 (1994-03-15) column 3, line 25 -column 7, line 49 examples	1-7
A	EP 0 480 724 A (JAMES RIVER CORP) 15 April 1992 (1992-04-15) page 2, line 35 -page 3, line 23	1-7
A	EP 0 959 165 A (MITSUI CHEMICALS INC) 24 November 1999 (1999-11-24) page 3, line 26 -page 5, line 6	1-7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 July 2001	07/08/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Stinchcombe, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 01/06909

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5294478 A	15-03-1994	AT 197541 T	15-12-2000
		AU 678432 B	29-05-1997
		AU 5952894 A	19-07-1994
		CA 2092605 A	19-06-1994
		DE 69329674 D	21-12-2000
		DE 69329674 T	21-06-2001
		EP 0636017 A	01-02-1995
		ES 2151545 T	01-01-2001
		JP 2000516864 T	19-12-2000
		MX 9307099 A	30-06-1994
		WO 9414397 A	07-07-1994
		US 5466513 A	14-11-1995
		ZA 9308001 A	09-06-1994
EP 0480724 A	15-04-1992	US 5246772 A	21-09-1993
		CA 2053384 A	13-04-1992
EP 0959165 A	24-11-1999	CN 1246164 T	01-03-2000
		WO 9928544 A	10-06-1999